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June 2003 Revised January 2005

NC7WP240

TinyLogic® ULP Dual Inverting Buffer with 3-STATE Outputs

General Description

The NC7WP240 is a Dual Inverting Buffer with independent active LOW enables for the 3-STATE outputs. The Ultra High Power device is ideal for applications where battery life is critical. This product is designed for ultra low power consumption within the $\rm V_{CC}$ operating range of 0.9V to 3.6V $\rm V_{CC}$.

The internal circuit is composed of a minimum of inverter stages, including the output buffer, to enable ultra low static and dynamic power.

The NC7WP240 for lower drive requirements, is uniquely designed for optimized power and speed, and is fabricated with an advanced CMOS technology to achieve best in class speed operation while maintaining extremely low CMOS power dissipation.

Features

- Space saving US8 surface mount package
- MicroPak™ Pb-Free leadless package
- 0.9V to 3.6V V_{CC} supply operation
- 3.6V overvoltage tolerant I/O's at V_{CC} from 0.9V to 3.6V
- t_{PD}

3.0 ns typ for 3.6V V_{CC} 4.0 ns typ for 2.3V to 2.7V V_{CC} 5.0 ns typ for 1.65V to 1.95V V_{CC} 6.0 ns typ for 1.40V to 1.60V V_{CC} 10.0 ns typ for 1.10V to 1.30V V_{CC} 26.0 ns typ for 0.90V V_{CC}

- Power-Off high impedance inputs and outputs
- Static Drive (I_{OH}/I_{OL}) ±2.6 mA @ 3.00V V_{CC}

±2.1 mA @ 2.30V V_{CC}

±1.5 mA @ 1.65V V_{CC}

±1.0 mA @ 1.40V V_{CC}

 ± 0.5 mA @ 1.10V $\rm V_{CC}$

±20 μA @ 0.9V V_{CC}

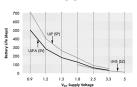
- Uses patented Quiet Series[™] noise/EMI reduction circuitry
- Ultra low dynamic power

Ordering Code:

Order Number	Package Number	Product Code Top Mark	Package Description	Supplied As
NC7WP240K8X	MAB08A	WP40	8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide	3k Units on Tape and Reel
NC7WP240L8X	MAC08A	Z3	Pb-Free 8-Lead MicroPak, 1.6 mm Wide	5k Units on Tape and Reel

Pb-Free package per JEDEC J-STD-020B.

Battery Life vs. V_{CC} Supply Voltage



TinyLogic ULP and ULP-A with up to 50% less power consumption can extend your battery life significantly. Battery Life = $(V_{battery}^{\dagger}, 9)/(P_{device})/24$ hrs/day

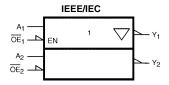
Where, P_{device} = (I_{CC} * V_{CC}) + (C_{PD} + C_L) * V_{CC}² * f

Assumes ideal 3.6V Lithium Ion battery with current rating of 900mAH and derated 90% and device frequency at 10MHz, with $\rm C_L=15~pF$ load

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Logic Symbol



Pin Descriptions

Pin Names	Description
ŌEn	Enable Inputs for 3-STATE Outputs
A _n	Inputs
Y _n	3-STATE Outputs

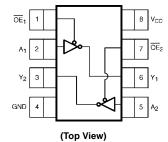
Function Table

Inp	Output			
ŌĒ	ŌE A _n			
L	L	Н		
L	Н	L		
Н	L	Z		
Н	Н	Z		

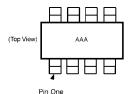
H = HIGH Logic Level

Connection Diagrams

Pin Assignments for US8



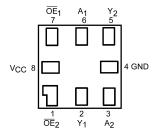
Pin One Orientation Diagram



AAA represents Product Code Top Mark - see ordering code

Note: Orientation of Top Mark determines Pin One location. Read the top
product code mark left to right, Pin One is the lower left pin (see diagram).

Pad Assignment for MicroPak



(Top Thru View)

L = LOW Logic Level Z = 3-STATE

Absolute Maximum Ratings(Note 1)

$\begin{array}{lll} \mbox{Supply Voltage (V$_{CC}$)} & -0.5 \mbox{V to } +4.6 \mbox{V} \\ \mbox{DC Input Voltage (V$_{IN}$)} & -0.5 \mbox{V to } +4.6 \mbox{V} \\ \end{array}$

DC Output Voltage (V_{OUT}) HIGH or LOW State (Note 2)

 $\label{eq:VCC} \begin{array}{ll} \mbox{HIGH or LOW State (Note 2)} & -0.5\mbox{V to V}_{CC} + 0.5\mbox{V} \\ \mbox{V}_{CC} = 0\mbox{V} & -0.5\mbox{V to +4.6\mbox{V}} \\ \mbox{DC Input Diode Current (I}_{IK}) \mbox{V}_{IN} < 0\mbox{V} & \pm 50 \mbox{ mA} \\ \end{array}$

DC Output Diode Current (I_{OK})

 $\begin{array}{lll} \rm V_{OUT} < 0V & -50~mA \\ & \rm V_{OUT} > V_{CC} & +50~mA \\ DC~Output~Source/Sink~Current~(I_{OH}/I_{OL}) & \pm~50~mA \\ \end{array}$

DC V_{CC} /Ground Current per

Supply Pin (I_{CC} or Ground) ± 50 mA Storage Temperature Range (T_{STG}) -65° C to $+150^{\circ}$ C

Recommended Operating Conditions (Note 3)

Supply Voltage 0.9V to 3.6VInput Voltage (V_{IN}) 0V to 3.6V

Output Voltage (V_{OUT})

HIGH or LOW State $$\rm OV\ to\ V_{CC}$$ $\rm V_{CC}=\rm OV$ $\rm OV\ to\ 3.6V$

Output Current in I_{OH}/I_{OL}

 $\begin{array}{lll} {\rm V_{CC}} = 3.0 {\rm V} \ {\rm to} \ 3.6 {\rm V} & \pm 2.6 \ {\rm mA} \\ {\rm V_{CC}} = 2.3 {\rm V} \ {\rm to} \ 2.7 {\rm V} & \pm 2.1 \ {\rm mA} \\ {\rm V_{CC}} = 1.65 {\rm V} \ {\rm to} \ 1.95 {\rm V} & \pm 1.5 \ {\rm mA} \\ \end{array}$

 $\begin{array}{lll} V_{CC} = 1.40 V \ to \ 1.60 V & \pm 1.0 \ mA \\ V_{CC} = 1.10 V \ to \ 1.30 V & \pm 0.5 \ mA \\ V_{CC} = 0.9 V & \pm 20 \ \mu A \end{array}$

Free Air Operating Temperature (T_A) $-40^{\circ}C$ to $+85^{\circ}C$

Minimum Input Edge Rate (Δt/ΔV)

 $V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$ 10 ns/V

Note 1: Absolute Maximum Ratings: are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 2: I_O Absolute Maximum Rating must be observed.

Note 3: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	V _{CC}	$T_A = $	+25°C	$T_{A} = -40^{\circ}C \text{ to } +85^{\circ}C$			Conditions
Symbol	raiametei	(V)	Min	Max	Min	Max	Units	Conditions
V _{IH}	HIGH Level	0.90	0.65 x V _{CC}		0.65 x V _{CC}			
	Input Voltage	$1.10 \le V_{CC} \le 1.30$	0.65 x V _{CC}		0.65 x V _{CC}			
		$1.40 \le V_{CC} \le 1.60$	0.65 x V _{CC}		0.65 x V _{CC}		V	
		$1.65 \le V_{CC} \le 1.95$	0.65 x V _{CC}		0.65 x V _{CC}		v	
		$2.30 \le V_{CC} \le 2.70$	1.6		1.6			
		$3.00 \le V_{CC} \le 3.60$	2.1		2.1			
V _{IL}	LOW Level	0.90		0.35 x V _{CC}		0.35 x V _{CC}		
	Input Voltage	$1.10 \le V_{CC} \le 1.30$		$0.35 \times V_{\rm CC}$		$0.35 \times V_{\rm CC}$		
		$1.40 \le V_{CC} \le 1.60$		$0.35 \times V_{\rm CC}$		$0.35 \times V_{\rm CC}$	V	
		$1.65 \le V_{CC} \le 1.95$		$0.35 \times V_{\rm CC}$		$0.35 \times V_{\rm CC}$	v	
		$2.30 \leq V_{CC} \leq 2.70$		0.7		0.7		
		$3.00 \le V_{CC} \le 3.60$		0.9		0.9		
V _{OH}	HIGH Level	0.90	V _{CC} - 0.1		V _{CC} - 0.1			
	Output Voltage	$1.10 \le V_{CC} \le 1.30$	V _{CC} - 0.1		V _{CC} - 0.1			
		$1.40 \le V_{CC} \le 1.60$	V _{CC} - 0.1		V _{CC} - 0.1			$I_{OH} = -20 \mu A$
		$1.65 \le V_{CC} \le 1.95$	V _{CC} - 0.1		V _{CC} - 0.1			10H = -20 μA
		$2.30 \leq V_{CC} \leq 2.70$	V _{CC} - 0.1		V _{CC} - 0.1			
		$3.00 \le V_{CC} \le 3.60$	V _{CC} - 0.1		V _{CC} - 0.1		V	
		$1.10 \le V_{CC} \le 1.30$	0.75 x V _{CC}		0.70 x V _{CC}			$I_{OH} = -0.5 \text{ mA}$
		$1.40 \le V_{CC} \le 1.60$	1.70		0.99			$I_{OH} = -1.0 \text{ mA}$
		$1.65 \le V_{CC} \le 1.95$	1.24		1.22			$I_{OH} = -1.5 \text{ mA}$
		$2.30 \le V_{CC} \le 2.70$	1.95		1.87			$I_{OH} = -2.1 \text{ mA}$
		$3.00 \le V_{CC} \le 3.60$	2.61		2.55			$I_{OH} = -2.6 \text{ mA}$

DC Electrical Characteristics (Continued)

Symbol	Parameter	V _{CC}	T _A = +25°C	$T_A = -40^{\circ}C \text{ to } +85^{\circ}C$	Units	Conditions
Cymbol	i didilicici	(V)	Min Max	Min Max	Oilles	Conditions
V _{OL}	LOW Level	0.90	0.1	0.1		
	Output Voltage	$1.10 \le V_{CC} \le 1.30$	0.1	0.1		
		$1.40 \le V_{CC} \le 1.60$	0.1	0.1		I _{OL} = 20 μA
		$1.65 \le V_{CC} \le 1.95$	0.1	0.1		I _{OL} = 20 μA
		$2.30 \leq V_{CC} \leq 2.70$	0.1	0.1		
		$3.00 \le V_{CC} \le 3.60$	0.1	0.1	V	
		$1.10 \le V_{CC} \le 1.30$	0.30 x V _{CC}	0.30 x V _{CC}		$I_{OL} = 0.5 \text{ mA}$
		$1.40 \le V_{CC} \le 1.60$	0.31	0.37		I _{OL} = 1.0 mA
		$1.65 \le V_{CC} \le 1.95$	0.31	0.35		I _{OL} = 1.5 mA
		$2.30 \leq V_{CC} \leq 2.70$	0.31	0.33		I _{OL} = 2.1 mA
		$3.00 \leq V_{CC} \leq 3.60$	0.31	0.33		I _{OL} = 2.6 mA
I _{IN}	Input Leakage Current	0.90 to 3.60	±0.1	±0.5	μΑ	$0 \le V_I \le 3.6V$
I _{OZ}	3-STATE Output	0.90 to 3.60	±0.5	±0.5		$V_I = V_{IH}$ or V_{IL}
	Leakage	0.50 10 3.60	±0.5	±0.5	μΑ	$0 \le V_O \le 3.6V$
I _{OFF}	Power Off Leakage Current	0	0.5	0.5	μΑ	$0 \le (V_I, V_O) \le 3.6V$
I _{CC}	Quiescent Supply Current	0.90 to 3.60	0.9	0.9	μΑ	$V_I = V_{CC}$ or GND

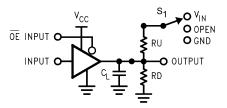
AC Electrical Characteristics

Symbol	Parameter	v _{cc}		$T_A = +25^{\circ}C$;	T _A = -40°	C to +85°C	Units	Conditions	Figure
Symbol	Parameter	(V)	Min	Тур	Max	Min	Max	Units	Conditions	Number
t _{PHL} ,	Propagation Delay	0.90		26.0						
t _{PLH}		$1.10 \le V_{CC} \le 1.30$	4.0	10.0	19.1	3.5	39.6			
		$1.40 \leq V_{CC} \leq 1.60$	2.0	6.0	11.2	1.5	14.5	ns	$C_L = 10 pF$	Figures
		$1.65 \le V_{CC} \le 1.95$	1.5	5.0	8.6	1.0	11.6	115	$R_L = 1 M\Omega$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.0	4.0	6.3	0.8	8.2			
		$3.00 \leq V_{CC} \leq 3.60$	1.0	3.0	5.3	0.5	7.2			
t _{PZH} ,	Output	0.90		29.0					C _L = 10 pF	
t_{PZL}	Enable Time	$1.10 \le V_{CC} \le 1.30$	4.0	8.0	17.5	3.5	40.4		$R_U = 500\Omega$	
		$1.40 \le V_{CC} \le 1.60$	2.0	6.0	11.9	1.5	14.8	ns	$R_D = 5000\Omega$	Figures
		$1.65 \leq V_{CC} \leq 1.95$	1.5	5.0	9.7	1.0	12.3	115	$S_1 = GND \text{ for } t_{PZH}$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.0	4.0	7.7	0.8	10.5		$S_1 = V_1$ for t_{PZL}	
		$3.00 \leq V_{CC} \leq 3.60$	1.0	3.0	6.9	0.5	8.6			
t _{PHZ} ,	Output	0.90		28.0					C _L = 10 pF	
t_{PLZ}	Disable Time	$1.10 \le V_{CC} \le 1.30$	4.0	8.0	20.5	3.5	42.0		$R_U = 500\Omega$	
		$1.40 \le V_{CC} \le 1.60$	2.0	6.0	15.3	1.5	18.0	ns R _D =	$R_D = 5000\Omega$	Figures
		$1.65 \leq V_{CC} \leq 1.95$	1.5	5.0	14.7	1.0	17.8	115	$S_1 = GND \text{ for } t_{PHZ}$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.0	4.0	13.7	0.8	15.0		$S_1 = V_1$ for t_{PLZ}	
		$3.00 \leq V_{CC} \leq 3.60$	1.0	3.0	13.5	0.5	14.8			
t _{PHL} ,	Propagation Delay	0.90		28.0						
t_{PLH}		$1.10 \leq V_{CC} \leq 1.30$	5.0	10.0	20.5	4.5	42.5			
		$1.40 \leq V_{CC} \leq 1.60$	3.0	7.0	11.8	2.5	15.4	ns	C _L = 15 pF	Figures
		$1.65 \leq V_{CC} \leq 1.95$	2.0	5.0	9.1	2.0	12.2	115	$R_L = 1 M\Omega$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.5	4.0	6.6	1.0	8.6			
		$3.00 \leq V_{CC} \leq 3.60$	1.0	3.0	5.6	0.5	7.5			
t _{PZH} ,	Output	0.90		31.0					C _L = 15 pF	
t_{PZL}	Enable Time	$1.10 \le V_{CC} \le 1.30$	5.0	11.0	18.2	4.5	43.3		$R_U = 5000\Omega$	2
		$1.40 \leq V_{CC} \leq 1.60$	3.0	7.0	12.5	2.5	15.5	ns	$R_D = 5000\Omega$	Figures
		$1.65 \leq V_{CC} \leq 1.95$	2.0	5.0	10.2	2.0	12.9	113	$S_1 = GND \text{ for } t_{PZH}$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.5	4.0	8.0	1.0	9.9		$S_1 = V_I \text{ for } t_{PZL}$	
		$3.00 \leq V_{CC} \leq 3.60$	1.0	3.0	7.2	0.5	8.9			

AC Electrical Characteristics (Continued)

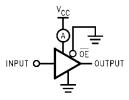
Symbol	Parameter	V _{cc}		$T_A = +25^{\circ}C$;	T _A = -40°	C to +85°C	Units	Conditions	Figure
Symbol	Farameter	(V)	Min	Тур	Max	Min	Max	Units	Conditions	Number
t _{PHZ} ,	Output	0.90		30.0					C _L = 15 pF	
t _{PLZ}	Disable Time	$1.10 \leq V_{CC} \leq 1.30$	5.0	11.0	21.6	4.5	44.9		$R_U = 5000\Omega$	
		$1.40 \leq V_{CC} \leq 1.60$	3.0	7.0	15.9	2.5	18.8	ns	$R_D = 5000\Omega$	Figures
		$1.65 \leq V_{CC} \leq 1.95$	2.0	5.0	15.2	2.0	18.2	115	$S_1 = GND \text{ for } t_{PHZ}$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.5	4.0	14.1	1.0	15.4		$S_1 = V_I \text{ for } t_{PLZ}$	
		$3.00 \leq V_{CC} \leq 3.60$	1.0	3.0	13.9	0.5	15.1			
t _{PHL} ,	Propagation Delay	0.90		34.0						
t _{PLH}		$1.10 \leq V_{CC} \leq 1.30$	5.5	12.0	23.4	5.0	51.1			
		$1.40 \leq V_{CC} \leq 1.60$	4.0	8.0	13.8	3.0	17.7	ns	C _L = 30 pF	Figures
		$1.65 \leq V_{CC} \leq 1.95$	2.0	6.0	10.6	2.0	14.0	115	$R_L = 1 M\Omega$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.0	5.0	7.6	1.0	9.9			
		$3.00 \leq V_{CC} \leq 3.60$	0.8	4.0	6.4	0.5	8.9			
t _{PZH} ,	Output	0.90		37.0					C _L = 30 pF	
t _{PZL}	Enable Time	$1.10 \leq V_{CC} \leq 1.30$	6.0	13.0	24.4	5.0	51.9		$R_U = 5000\Omega$	
		$1.40 \leq V_{CC} \leq 1.60$	4.0	8.0	14.5	3.0	17.9	ns	$R_D = 5000\Omega$	Figures
		$1.65 \leq V_{CC} \leq 1.95$	2.0	6.0	11.7	2.0	14.7	115	$S_1 = GND \text{ for } t_{PZH}$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.0	5.0	9.1	1.0	11.1		$S_1 = V_I \text{ for } t_{PZL}$	
		$3.00 \leq V_{CC} \leq 3.60$	0.8	4.0	8.1	0.5	10.1			
t _{PHZ} ,	Output	0.90		36.0					C _L = 30 pF	
t _{PLZ}	Disable Time	$1.10 \leq V_{CC} \leq 1.30$	6.0	13.0	24.8	5.0	53.5		$R_U = 5000\Omega$	
		$1.40 \leq V_{CC} \leq 1.60$	4.0	8.0	17.1	3.0	21.1	ns	$R_D = 5000\Omega$	Figures
		$1.65 \leq V_{CC} \leq 1.95$	2.0	6.0	16.5	2.0	20.5	115	$S_1 = GND \text{ for } t_{PHZ}$	1, 2
		$2.30 \leq V_{CC} \leq 2.70$	1.0	5.0	15.2	1.0	16.7		$S_1 = V_I \text{ for } t_{PLZ}$	
		$3.00 \leq V_{CC} \leq 3.60$	0.8	4.0	14.8	0.5	16.3			
C _{IN}	Input Capacitance	0		2.0				pF		
C _{OUT}	Output Capacitance	0		4.0				pF		
C _{PD}	Power Dissipation Capacitance	0.9 to 3.60		10.0				pF	$V_I = V_O \text{ or } V_{CC},$ f = 10 MHZ	

AC Loading and Waveforms



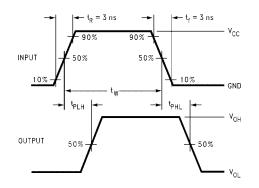
 $\mathrm{C_L}$ includes load and stray capacitance Input PRR = 1.0 MHz; $\mathrm{t_W} = 500~\mathrm{ns}$

FIGURE 1. AC Test Circuit



 $\begin{aligned} & \text{Input} = \text{AC Waveform; } t_r = t_f = 1.8 \text{ ns;} \\ & \text{PRR} = 10 \text{ MHz; Duty Cycle} = 50\% \end{aligned}$

FIGURE 2. I_{CCD} Test Circuit



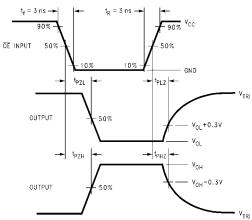


FIGURE 3. AC Waveforms

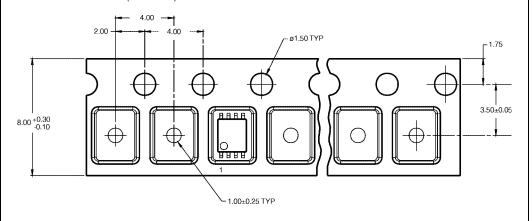
Symbol			V	cc		
5,25.	$3.3V \pm 0.3V$	$\textbf{2.5V} \pm \textbf{0.2V}$	1.8V ± 0.15V	1.5V ± 0.10V	1.2V ± 0.10V	0.9V
V _{mi}	1.5V	V _{CC} /2	V _{CC} /2	V _{CC} /2	V _{CC} /2	V _{CC} /2
V _{mo}	0.3V	0.15V	0.15V	0.10V	0.10V	0.10V

Tape and Reel Specification

TAPE FORMAT for US8

TAIL TOKINATION	700				
Package	Таре	Number	Cavity	Cover Tape	
Designator	Section	Cavities	Status	Status	
	Leader (Start End)	125 (typ)	Empty	Sealed	
K8X	Carrier	3000	Filled	Sealed	
	Trailer (Hub End)	75 (typ)	Empty	Sealed	

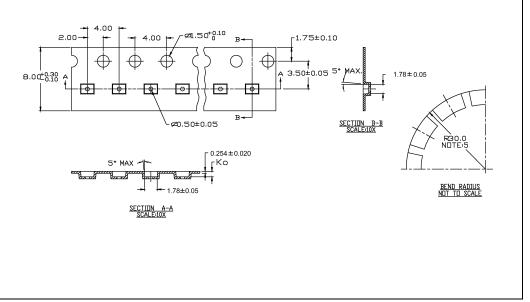
TAPE DIMENSIONS inches (millimeters)



TAPE FORMAT for MicroPak

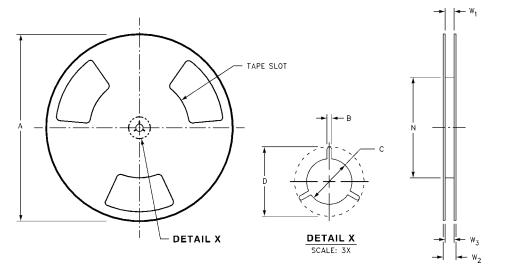
Package	Tape	Number	Cavity	Cover Tape
Designator	Section	Cavities	Status	Status
	Leader (Start End)	125 (typ)	Empty	Sealed
L8X	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

TAPE DIMENSIONS inches (millimeters)



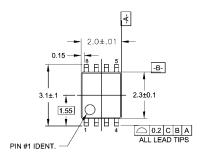
Tape and Reel Specification (Continued)

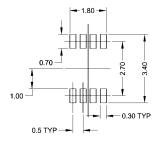
REEL DIMENSIONS inches (millimeters)



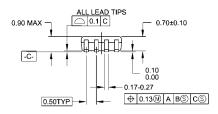
Tape Size	Α	В	С	D	N	W1	W2	W3
0	7.0	0.059	0.512	0.795	2.165	0.331 + 0.059/-0.000	0.567	W1 + 0.078/-0.039
8 mm	(177.8)	(1.50)	(13.00)	(20.20)	(55.00)	(8.40 + 1.50/-0.00)	(14.40)	(W1 + 2.00/-1.00)

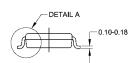
Physical Dimensions inches (millimeters) unless otherwise noted

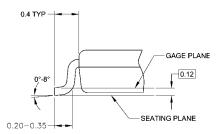




LAND PATTERN RECOMMENDATION







NOTES:

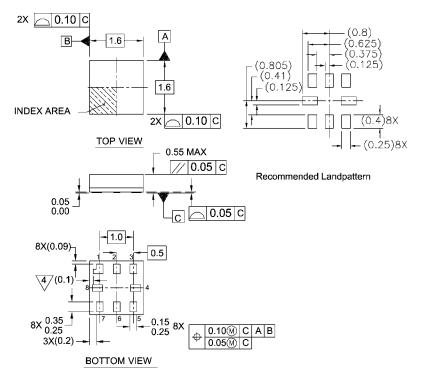
- CONFORMS TO JEDEC REGISTRATION MO-187
 B. DIMENSIONS ARE IN MILLIMETERS.
 C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

DETAIL A

MAB08AREVC

8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide Package Number MAB08A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Notes:

- 1. PACKAGE CONFORMS TO JEDEC MO-255 VARIATION UAAD
- 2. DIMENSIONS ARE IN MILLIMETERS
- 3. DRAWING CONFORMS TO ASME Y.14M-1994

4/PIN 1 FLAG, END OF PACKAGE OFFSET.

MAC08AREVC

Pb-Free 8-Lead MicroPak, 1.6 mm Wide Package Number MAC08A

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